

CLAIMS

What is claimed is:

1. An isolated nucleic acid molecule selected from the group consisting of:
 - (a) a nucleic acid molecule comprising a nucleic acid sequence selected from the group consisting of SEQ ID NO:1, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18, SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:28, SEQ ID NO:29, SEQ ID NO:32, SEQ ID NO:34, SEQ ID NO:36, SEQ ID NO:37, SEQ ID NO:38, SEQ ID NO:41, SEQ ID NO:43, and SEQ ID NO:45;
 - (b) a nucleic acid molecule comprising at least a portion of any of said nucleic acid molecules of (a);
 - (c) a complement of a of a nucleic acid molecule of (a) or (b); and
 - (d) a nucleic acid molecule comprising an allelic variant of a nucleic acid molecule comprising any of said nucleic acid sequences.
2. The nucleic acid molecule of claim 1, wherein said nucleic acid molecule is a plant nucleic acid molecule.
3. The nucleic acid molecule of claim 1, wherein said nucleic acid molecule is selected from the group consisting of *Arabidopsis*, *Oryza*, *Glycine*, *Hordeum*, *Zea*, *Medicago*, *Allium*, *Citrus*, *Solanum*, *Sorghum*, *Saccharum*, *Nicotiana*, *Lycopersicon*, *Triticum*, *Zinnia*, and *Phaseolus* nucleic acid molecules.
4. The nucleic acid molecule of claim 1, wherein said nucleic acid molecule is selected from the group consisting of: a nucleic acid molecule comprising a nucleic acid sequence that encodes a protein having an amino acid sequence selected from the group consisting of SEQ ID NO:3, SEQ ID NO:7, SEQ ID NO:9, SEQ ID NO:12, SEQ ID NO:15, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:22, SEQ ID NO:24, SEQ ID NO:26, SEQ ID NO:31, SEQ ID NO:33, SEQ ID NO:35, SEQ ID NO:40, SEQ ID NO:42, SEQ ID NO:44, SEQ ID NO:47, and SEQ ID NO:65; and a nucleic

acid molecule comprising an allelic variant of a nucleic acid molecule encoding a protein having any of said amino acid sequences.

5. An isolated protein encoded by a plant MSH1 nucleic acid molecule that hybridizes to the complement of a nucleic acid molecule having a nucleic acid sequence selected from the group consisting of SEQ ID NO:1, SEQ ID NO:6, SEQ ID. NO:8, SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18, SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:28, SEQ ID NO:29, SEQ ID. NO:32, SEQ ID NO:34, SEQ ID NO:36, SEQ ID NO:37, SEQ ID NO:38, SEQ ID NO:41, SEQ ID NO:43, and SEQ ID NO:45 under stringent hybridization conditions.

6. An isolated protein comprising a plant MSH1 protein.

7. The protein of claim 5, wherein said protein comprises an amino acid sequence selected from the group consisting of SEQ ID NO:3, SEQ ID NO:7, SEQ ID NO.:9, SEQ ID NO.:12, SEQ ID NO.:15, SEQ ID NO:17, SEQ ID NO.:19, SEQ ID NO.:22,SEQ ID NO.:24, SEQ ID NO.:26, SEQ ID NO.:31,SEQ ID NO:33, SEQ ID NO.:35, SEQ ID NO.:40, SEQ ID NO.:42, SEQ ID NO:44, SEQ ID NO:47 and SEQ ID NO:65.

8. The protein of claim 5, wherein said protein comprises at least a portion of an amino acid sequence selected from the group consisting of SEQ ID NO:3, SEQ ID NO:7, SEQ ID NO.:9, SEQ ID NO.:12, SEQ ID NO.:15, SEQ ID NO:17, SEQ ID NO.:19, SEQ ID NO.:22,SEQ ID NO.:24, SEQ ID NO.:26, SEQ ID NO.:31,SEQ ID NO:33, SEQ ID NO.:35, SEQ ID NO.:40, SEQ ID NO.:42, SEQ ID NO:44, SEQ ID NO:47 and SEQ ID NO:65.

9. A method to identify a compound capable of inhibiting MSH1 activity of a plant, said method comprising:

(a) contacting an isolated plant MSH1 nucleic acid molecule selected from the group consisting of SEQ ID NO:1, SEQ ID NO:6, SEQ ID. NO:8, SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:13, SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:18,

SEQ ID NO:21, SEQ ID NO:23, SEQ ID NO:25, SEQ ID NO:27, SEQ ID NO:28, SEQ ID NO:29, SEQ ID NO:32, SEQ ID NO:34, SEQ ID NO:36, SEQ ID NO:37, SEQ ID NO:38, SEQ ID NO:41, SEQ ID NO:43, and SEQ ID NO:45 with a putative inhibitory compound which, in the absence of said compound, said plant MSH1 nucleic acid molecule has the activity of suppressing ectopic recombination; and

(b) determining if said putative inhibitory compound inhibits said activity.

10. The method of claim 9, wherein the putative inhibitory compound is a RNA molecule suspected of having RNAi activity.

11. A compound identified by the method of Claim 9.

12. A method for identification of plant mutants arising from mitochondrial ectopic recombination comprising

- (a) providing a plant,
- (b) suppressing expression of an *MSH1*-homologous gene in the plant,

and

- (c) detecting an aberrant phenotype,

whereby a plant mutant is identified.

13. The method of claim 12, wherein said suppressing expression of an *MSH1*-homologous gene in said plant comprises contacting said plant with an compound identified by the method of Claim 9.

14. The method of claim 12, wherein said aberrant phenotype is cytoplasmic male sterility.

15. A plant mutant identified by the method of claim 12.